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NATIONAL DAM SAFETY PROGRAM. MOSS NUMBER 2 (INVENTORY NUMBER VA--ETC(U)
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SEPTEMBER, 1979

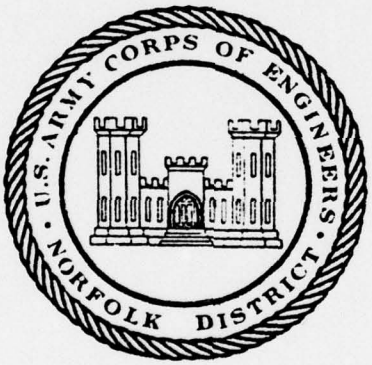
Name Of Dam: MOSS NO. 2

Location: RUSSELL COUNTY, VIRGINIA

Inventory Number: VA. NO. 16705

LEVEL II

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS AND ASSOCIATES, INC.

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20. Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

(1)

NAME OF DAM: MOSS NO. 2
LOCATION: RUSSELL COUNTY, VIRGINIA
INVENTORY NUMBER: VA. NO. 16705

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED FOR
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS AND ASSOCIATES, INC.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

Name: Moss No. 2 Dam Va. No. 16705
State: Virginia
County: Russell
USGS Quad Sheet: Carbo
Coordinates: Lat 36°-59.3' Long 82°-11'
Stream: Unnamed Tributary to Hurricane Fork
Date of Inspection: June 11, 1979

BRIEF ASSESSMENT OF DAM

Moss No. 2 Dam is a heterogeneous cross-valley mine waste structure about 500 ft long and 165 ft high. The height of the dam above the sediment is estimated to be about 10 ft. The maximum water depth is estimated to be 5 ft. The principal spillway consists of a 10 ft wide concrete channel at the right side of the embankment. Water is expelled into a rock outlet channel along the right embankment-abutment junction. There is also a diversion channel (8 ft bottom width, trapezoidal shape) located at the right embankment-abutment junction, which also serves as an emergency spillway. Other diversion ditches are presently under construction around the remainder of the perimeter of the pond.

The dam is located on an unnamed tributary of the Hurricane Fork about 2 miles north of South Clinchfield, Virginia. The dam was constructed in three stages during the period 1955 to 1967 and was used for coal mining refuse disposal. The dam is owned and maintained by the Clinchfield Coal Company.

Modification of the dam began in 1972 and the dam is

scheduled for abandonment as a refuse disposal area by 1980. Plans have been prepared showing the abandonment procedure and these are currently being implemented. Abandonment is by filling the sediment pond with mine waste and filling the downstream slope with mine waste. Stormwater is diverted through the site by means of a perimeter diversion channel capable of containing a 100-year flood.

The dam is an "intermediate" size and is rated a "significant" hazard. The principal spillway and emergency spillway will pass 25% of the PMF without overtopping the dam. The appropriate spillway design flood (SDF) is the ½ PMF, and during the SDF the dam will be overtopped by 1.5 feet for 2.5 hours at a critical velocity of 4.8 fps. Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the spillway is rated inadequate but not seriously inadequate. Improvements to the spillway are not recommended due to the abandonment completion scheduled for 1980.

The actual embankment structure and reservoir diversion channel appear to be similar to the design drawings for the abandonment of the dam. The stability analysis for the original dam prior to the modifications presently in progress indicates the embankment meets the criteria included in Reference I, Appendix VII. The present modifications will improve the stability of the structure.

The visual inspection revealed no serious problems; however, erosion in the outlet channel should be repaired within the next 6 months.

Prepared by:

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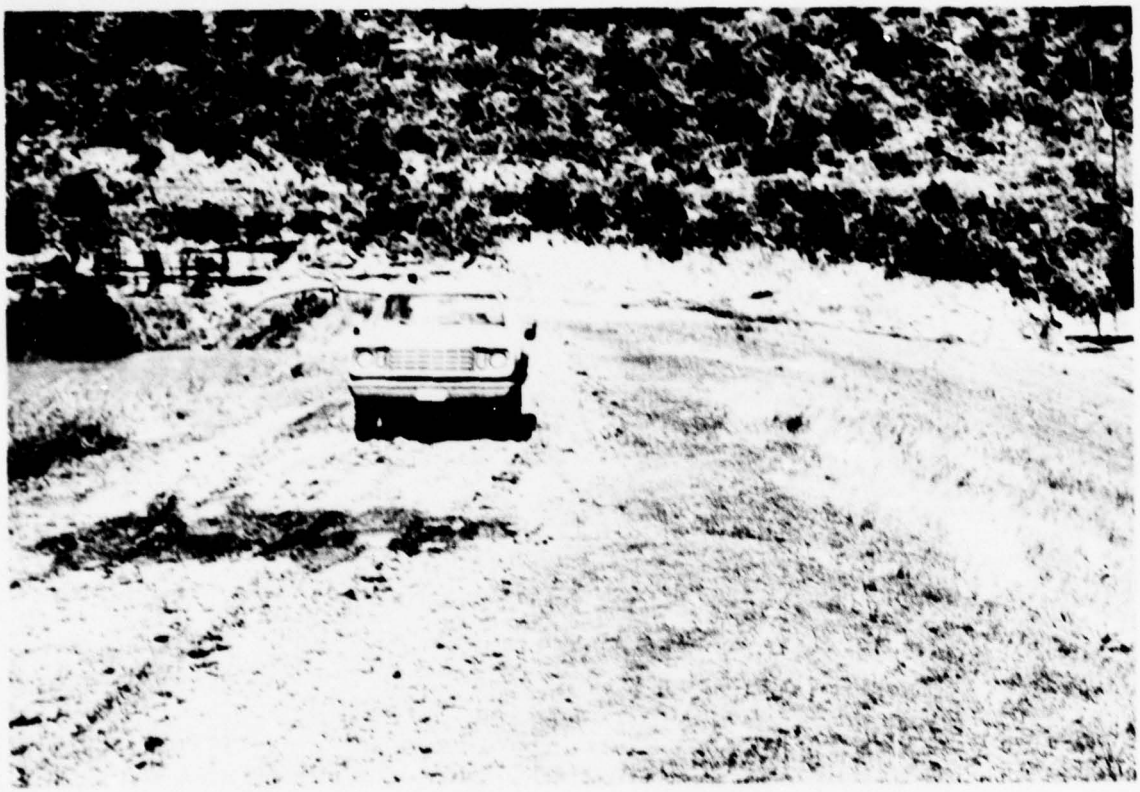
Chief, Engineering Division

Date: SEP 27 1979



OVERVIEW PHOTO

(Note: Vertical wall in background is Typical of slope found around reservoir.)

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MOSS NO. 2 DAM
VA. NO. 16705

SECTION 1 - PROJECT INFORMATION

1.1 General:

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (See Reference 1, Appendix VII). The main responsibility is to expeditiously identify those dams which may be a potential threat to human life or property.

1.2 Project Description:

1.21. Dam and Appurtenances: Moss No. 2 Dam is a heterogeneous cross-valley mine waste structure approximately 500 ft long and 165 ft high.* The dam has a clay core and has been constructed with slurry, coarse coal refuse and earth fill materials. Slurry consists of coal fines suspended in wash water and coarse coal refuse generally consists of rock debris with nonplastic fines.

*This is the height above natural ground in lieu of height to downstream toe.

Both are byproducts of the coal preparation process. The water depth is estimated at about 5 ft. There is about 6 ft to 10 ft of freeboard above the present water level at this time and the height of the dam is estimated to be about 10 ft. The top of the dam is 30 to 50 ft wide and is at elevation 1980 msl. Side slopes of 3 horizontal to 1 vertical (3:1) are under construction on the downstream side with two intermediate 20 ft wide benches. The original downstream slope was about 1.4:1. The upstream slope varies from 1:1 to 1.4:1.

The principal spillway consists of a 10 ft wide by 5 ft high concrete channel approximately 40 ft long (invert elevation 1974 msl) located along the right end of the embankment. An emergency spillway has recently been constructed to the right of the principal spillway with an 8 ft bottom width and 1:1 side slopes. The overflow section for the emergency spillway is at elevation 1977msl. The emergency spillway flows into a diversion channel located along the right abutment and parallel to the principal spillway. Both the emergency spillway and principal spillway combine into one channel below the principal spillway. This outlet channel follows the right embankment-abutment junction to the toe of the embankment which is at approximately elevation 1770 msl. The channel then passes through a 12.5 ft^{+} wide by 8.25 ft high corrugated metal arch pipe under Va. Route 621 into a broad floodplain.

1.2.2 Location: Moss No. 2 Dam is located on an

unnamed tributary of Hurricane Fork 2 miles north of South Clinchfield, Virginia (See Plate 1, Appendix I).

1.2.3 Size Classification: The dam is classified as an "intermediate" size structure because of the dam's hydraulic height and storage potential. Although the dam is an intermediate size structure, the storage potential is extremely small due to siltation to within 10 ft of the dam crest .

1.2.4 Hazard Classification: The dam is located in a rural area; however, based upon the downstream proximity of the Moss No. 2 coal preparation plant, the dam is assigned a "significant" hazard classification. The hazard classification used to categorize a dam is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: The dam is owned by the Clinchfield Coal Company.

1.2.6 Purpose: Coal refuse disposal area.

1.2.7 Design and Construction History:

The dam was constructed in three stages from 1955 to 1967 under the supervision of the Clinchfield Coal Company. No design drawings or data were available for the original design. L. Robert Kimball, Consulting Engineers, Ebensburg, Pennsylvania, prepared a Future Use and Abandonment Plan in 1976. Implementation of this abandonment plan is currently under way with completion scheduled for 1980. Abandonment involves the complete filling of the impoundment and the

diversion of all runoff away from the impounded area. Orbital Engineering, Pittsburgh, Pennsylvania is presently preparing working drawings for the abandonment and Clinchfield Coal Company personnel are observing construction.

1.2.8 Normal Operational Procedures: The principal spillway is ungated; therefore, water rising above the crest of the outlet channel is automatically discharged downstream in quantities based on the channel capacity. Similarly, water is automatically passed through the diversion channel in the event of an extreme flood which creates a pool elevation above that of the emergency spillway. Upon completion of the diversion channel, all precipitation falling within the drainage basin will be routed through the perimeter diversion channels with the exception of that occurring in the pond area.

1.3 Pertinent Data:

1.3.1 Drainage Areas: The drainage area is 0.7 square miles which was determined from the 1:24,000 U.S.G.S. quadrangle of the area.

1.3.2 Discharge at Dam Site: Maximum known flood at the dam site occurred in April 1977; however, the pool elevation was not observed.

Principal Spillway Discharge:

Pool Elevation at Crest of Dam (elev 1980 msl) 456 CFS

Emergency Spillway Discharge:

Pool Elevation at Crest of Dam (elev. 1980 msl) 290 CFS

1.3.3 Dam and Reservoir Data: See Table 1.1 below.

Table 1.1 DAM AND RESERVOIR DATA

Item	Elevation Feet msl	Storage			
		Area Acres	Acre Feet	Watershed Inches	Length Miles
Crest of Dam	1980	19	110	2.64	.40
Emergency Spillway Crest	1977	16	60	1.44	.35
Principal Spillway Crest	1974	14	15	.36	.35
Streambed at Toe of Dam	1770	-	-	-	-

SECTION 2 - ENGINEERING DATA

2.1 Design: There is no design data for the original embankment; however, an engineering study and design drawings for abandonment of the structure were developed in 1976 by L. Robert Kimball, Consulting Engineers. The full scope of the study was to prepare a future use and abandonment, stabilization and hydrologic plan for the Moss No. 2 mine coal refuse disposal area (Reference 6, Appendix VII).

According to projected refuse production figures, this site will be used as a refuse disposal area until 1986±. Disposal of refuse will be done in a manner which will gradually eliminate the impoundment. A summary of the consultant's recommendations is presented in Appendix V.

The impoundment was constructed in three stages from 1955 to 1967. The embankment reportedly includes a compacted clay core which ranges in width from 112 ft at the base to 12 ft at the crest. The core is illustrated on Plate 4 of Appendix I. The first stage was completed in 1957 with crest at elevation 1889 msl. The dam was raised to elevation 1964 msl in 1958 and later raised to its present elevation in 1967. Upstream and downstream slopes were reportedly constructed at about 1.4 horizontal to 1 vertical. French drains were installed in 1972 to collect seepage along the downstream toe. A granular rock drainage blanket was also constructed extending 600 ft± downstream from the original toe of the dam.

The site has been inspected at least three times between 1973 and 1979, excluding this inspection. The inspection

summary presented in the report by L. Robert Kimball is included as Appendix VI.

Water level readings are given on the boring logs, which are included as Plate 3, Appendix I. Their locations are provided in Plate 2, Appendix I. Water levels were measured at elevations 1890, 1800 and 1773.5* in Borings B-1, B-2, and B-3, respectively on the dates indicated on the logs. These levels appear to represent the phreatic water level through the embankment. Pneumatic piezometers were installed in Borings B-1 and B-3 as described on the boring logs, and we understand periodic readings are obtained by the Owner's engineer.

The engineering report and supplementary data developed by Kimball Engineers includes laboratory test data describing the physical properties of the materials used to construct the embankment. Triaxial shear tests were performed on undisturbed and remolded samples of coarse coal refuse to identify strength characteristics of the existing soil conditions.

Summary of Triaxial (R) Test Results

Material	Sample	ϕ (°)	c (psi)	$\bar{\phi}$ (°)	$\bar{c}$ (psi)
Old Refuse	B-2-9	25.5	7.3	34.5	3.5
Clay	B-1-12	21.2	0	39.4	.75
Slurry	-	12.7	1.5	25.2	3.5
Coarse Refuse	Remolded New Refuse	11.0	8.0	24.7	5.0

The Simplified Bishop Method of Analysis was used in assessing the stability of the finished embankment. Stability analysis data are presented in Appendix IV.

2.2 Construction: Construction records were not available. The dam was reportedly constructed with equipment owned by Clinchfield Coal Company.

2.3 Operation: The dam was constructed in three stages between 1955 and 1967. The construction program included raising the height of the dam and installing french drains and a drainage blanket. Water observation wells were later installed to monitor the phreatic water levelalong the downstream slope. In 1976 a Future Use and Abandonment Plan was developed which presents procedures for completely filling the impoundment and diverting all runoff away from the impounded area. A summary of recommendations for implementing this plan is included in Appendix V and more detailed information is available from the Owner.

2.4 Evaluation: Original engineering calculations and drawings are not available, but the drawings for the abandonment plan are representative of the dam, and hydrolgic and hydraulic calculations are adequate. There are no other records available, except the records of the observation wells.

SECTION 3 - VISUAL INSPECTION

3.1 Findings: At the time of inspection the dam was generally in good condition. Field observations are outlined in Appendix III.

3.1.1 General: An inspection was made of the impoundment located at Moss No. 2 on June 11, 1979. At the time of inspection, the weather was fair and the temperature was 68°F. This impoundment is a coal refuse disposal area. The inspection revealed that the normal pool was at elevation 1974 msl. The tailwater in the stilling basin at the base of the embankment was at elevation 1770± msl. Ground conditions were dry at the time of inspection.

3.1.2 Dam and Spillway: The principal concrete spillway showed spalling and weathering, but was generally in good condition. Soils at the end of the concrete spillway exhibited some erosion and undermining and the embankment at the left edge of the spillway exhibited erosion. An emergency spillway was under construction which will tie into the downstream channel at the end of the spillway chute.

The embankment appears to be well maintained as a result of the continual grading of coal refuse, which is disposed along the downstream slope. Upon completion, the slope will conform to the abandonment plan. Only minor vegetation was present, and no seepage was encountered on the downstream slope. The seepage (2 gpm±) encountered above the left downstream embankment-abutment contact is located at least 100 ft± below the pool level. This seepage is believed to be unrelated to the

impoundment and is considered to be a spring. Erosion observed along the right downstream embankment-abutment junction is the result of surface runoff and discharge from the spillway. (See Photo 5, Appendix II).

Bedrock was exposed in the abutments, particularly along the right abutment. The bedrock is essentially flat-lying and consists of alternating beds of sandstone and shale with occasional thin interbeds of coal.

3.1.3 Reservoir Area: The reservoir area ranges from densely wooded to barren. This impoundment was used as a sediment basin for the coal washing discharge. Surface exposure of sediment within the reservoir was estimated to be 30 ft± from the right abutment and 200 ft± from the left abutment.

3.1.4 Downstream Area: The stilling basin appeared to be operating properly. Discharge is through an 8 ft 3 inch x 12 ft 6 inch corrugated metal arch pipe under Va. Route 621 at the toe of the embankment. The arch pipe is in good condition with no corrosion or collection of debris. At the outlet of the arch pipe is a broad floodplain in which a coal loading and washing operation is located.

3.2 Evaluation:

3.2.1 Dam and Spillway: The overall dam and spillway appeared to be in good condition. The abandonment plan developed in 1976 was being implemented and at the time of the inspection it appears that the Clinchfield Coal Company

was following the plan in general. Completion of the abandonment is scheduled for 1980. The erosion occurring at the lower end of the spillway should be corrected. It is understood that a plan for this has been prepared by Orbital Engineering.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: The Moss No. 2 Dam was used for disposal of coal wash slurry. This use has been terminated, and filling of the impoundment will be with coarse refuse hauled by truck. The normal pool depth is about 5 ft, and the runoff is automatically discharged through the spillway. The spillway is an overflow channel. Water automatically discharges through the channel as the pool rises and continues into the emergency spillway when the pool rises above elevation 1977.5± msl. The pool elevation is normally one inch over the spillway except during periods of rainfall. The elevation of the spillway has been previously adjusted to maintain an elevation approximately 10 ft± above the bottom of the sediment pool.

4.2 Maintenance of Dam and Appurtenances: Maintenance is the responsibility of the Clinchfield Coal Company. Work is in process for abandonment of this impoundment in accordance with the approved plan. Maintenance consists of correcting erosion problems, inspection of dam, and removal of debris from the spillway.

4.3 Warning System: No warning system exists at this time.

4.4 Evaluation: The operational procedures are automatic and the maintenance of the dam is good except for the lower end of the spillway where erosion has not been corrected.

SECTION 5 - HYDRAULICS/HYDROLOGIC DATA

5.1 Design: No data was available.

5.2 Hydrologic Records: There are no hydrologic records available for this drainage area.

5.3 Flood Experience: The maximum pool elevation observed was in April 1977; however, the pool elevation is not known.

5.4 Flood Potential: In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Appropriate adjustments for basin size and shape were accounted for and hydrograph procedures as outlined in Reference 4, Appendix VII were used for the flood hydrographs. These hydrographs were routed through the reservoir to determine maximum pool elevations.

5.5 Reservoir Regulation: For routing purposes, the pool at the beginning of the flood was assumed to be at elevation 1974 msl. Reservoir stage-storage data and stage-discharge data were determined from the available plans, reports, field measurements, and USGS quadrangle sheets. The principal spillway

and emergency spillway were utilized in flood routing. Storage above the dam crest was extrapolated from data in the abandonment report. Spillway and non-overflow section ratings were calculated using field measurements.

5.6 Overtopping Potential: The predicted rise of the reservoir pool and other pertinent data were determined by routing the flood hydrographs through the reservoir as previously described. The results for the flood conditions (PMF, ½PMF) are shown in the following Table 5.1.

TABLE 5.1 RESERVOIR PERFORMANCE

	Normal Flow	Hydrograph	
		½ PMF	PMF
Peak Flow, CFS			
Inflow	0.5	3966	7931
Outflow		3613	7165
Maximum Pool Elev., ft., msl		1981.5	1982.6
Non-Overflow Section (El 1980 msl)			
Depth of Flow, ft.		1.5	2.6
Duration, hrs		2.5	4.0
Velocity, fps *		4.8	6.5
Emergency Spillway El 1974 msl			
Head, ft		7.5	8.6
Duration, hrs		12.0	12.0
Velocity, fps *		12.2	13.0
Tailwater Elevation Ft., msl	1770	1788	1790

(*) critical velocity

5.7 Reservoir Emptying Potential: There is no method of lowering the reservoir below the principal spillway.

5.8 Evaluation: Department of the Army, COE, guidelines indicate the appropriate spillway design flood (SDF) for an intermediate size, significant hazard dam is the ½ PMF to PMF. Due to the risk involved the ½ PMF has been selected at the SDF. The spillway will pass 25% of the PMF. The SDF will overtop the dam by a maximum of 1.5 feet, remain above the dam for 2.5 hours with a critical velocity of 4.8 fps.

Hydrologic data used in the evaluation pertains to present day conditions with no consideration given to future development.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The dam site is located within the southeast portion of the Appalachian Plateau (locally Cumberland Plateau) Physiographic Province of Virginia. The Cumberland Plateau is a stream dissected plateau which is underlain by sedimentary rocks up to upper Pennsylvanian in age (see Reference 3, Appendix VII). Throughout much of Wise County the ground surface is extremely rugged. Flat lands are rare and valley slopes, though not precipitous, are very steep.

The dam site is underlain by rocks of the Norton Formation of Lower to Middle Pennsylvanian Age. This formation consists of alternate beds of sandstone and shale interbedded with coal. The sandstones are commonly soft and micaceous while the shales are largely clayey. In Russell County, the Norton Formation varies in thickness from 1300 to 1500 ft and thins in a northerly direction. Bedrock is generally flat-lying; however, the presence of the Hunter Valley fault to the southeast causes steepening of bedding dips.

Bedrock was exposed in the abutments, particularly along the right abutment. The bedrock is essentially flat-lying and consists of alternating beds of sandstone and shale with occasional thin interbeds of coal.

Boring logs indicate the dam is underlain by 11 to 17 ft± of overburden soils which consist of clayey to silty sands with varying amounts of gravel or boulders. Zones of gravel and boulders would probably represent alluvial and colluvial deposits present in the old stream channel. No faults were observed in the field during this investigation and geologic maps of the area do not show the presence of any faults in the immediate vicinity. Core recoveries from the underlying bedrock ranged from 48 to 86 percent and RQD* values of 0 to 46 percent were calculated on the NX (2 1/8 inch) cores. Core recoveries suggest the upper portion of bedrock is probably weathered and fractured.

6.2 Embankment: The downstream slope is presently being graded from 1.4:1 to 3:1. A 200 ft± wide bench exists at elevation 1880±; however the proposed abandonment plan requires that this area be filled with coarse coal refuse and two 20 ft wide benches be constructed at elevations 1900 and 1980. The upper bench was complete at the time of the inspection. The upstream slope is also 1.4:1. (See Plate 4, Appendix I)

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*Rock Quality Designation (RQD) is defined as the total length of rock core fragments recovered during drilling, which are greater than 4 inches in length, discounting drilling breaks and mudseams, expressed as a percentage of the total length cored.

6.3 Evaluation:

6.3.1 Foundation and Abutments: Dam foundations must be evaluated on the basis of potential settlement, sliding and seepage. Excessive settlement of the dam is not believed to be a problem since test boring data indicates the structure rests upon fairly competent bedrock and firm to compact alluvial, colluvial, and/or residual soils.

Sliding within the foundation bedrock would not normally appear to be a problem based upon the nature of the Norton Formation. A review of the geologic data indicates that there are probably no adversely oriented weak planes within the foundation rock that would act as a potential sliding plane. Previous experience with this formation makes it necessary to consider the presence of clay shales beneath the dam; however, the test boring data does not indicate the presence of this material. Based upon the performance of the dam over the past 20 years, sliding within the foundation would not appear to be a problem. The planned abandonment program also provides for a more stable structure.

The potential for seepage beneath the embankment does exist since the structure is underlain by sand and weathered bedrock (as indicated by core recoveries). It is not known whether the clay core keys into rock; however, materials encountered in Boring B-1 suggest that it does not. Furthermore, it would appear that the construction of a drainage

blanket along the downstream toe in 1972 would be for intercepting seepage through and/or beneath the dam. This drainage blanket appeared to be functioning properly and the only seepage observed was in the left abutment, flowing at an estimated rate of about 2 gpm.

The abutment slopes were considered stable at the time of the inspection. Bedrock exposed is essentially flat-lying and only minor sloughing was generally observed along the lower portions of the slopes.

6.3.2 Embankment: No undue settlement, cracking or seepage was noted at the time of inspection; thus it appears that the embankment is adequate for normal pool level with water at elevation 1974± msl. The stability analysis performed for the original embankment indicated conformance with the guidelines included in Reference 1, Appendix VII with respect to the steady seepage case. The rapid drawdown case was not considered since it is not possible for this type of loading condition to occur. Since the dam is presently being modified and stability analyses have been performed for this modification, no additional studies are recommended.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: Moss No. 2 Dam at the time of inspection was in good condition. The dam is an "intermediate" size, "significant" hazard structure. The appropriate design flood is the ½ PMF. The spillway will not pass the ½ PMF without overtopping the dam, and the spillway is considered inadequate, but not seriously inadequate. Maintenance at the time of inspection appeared to be adequate.

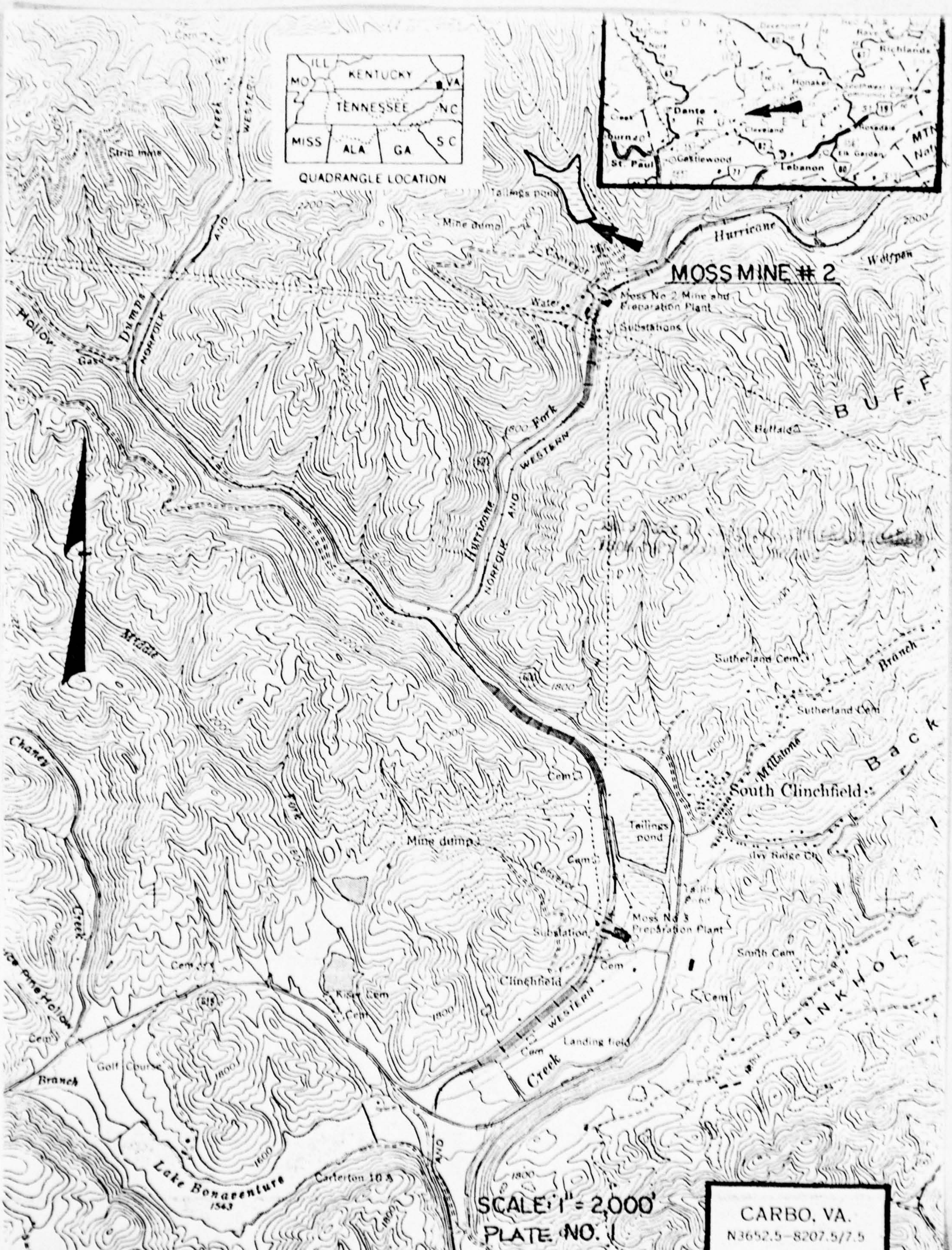
The actual embankment structure appears to be similar to abandonment drawings. The stability analysis performed for the steady seepage case for the embankment prior to modification indicates the factor of safety conforms to the requirements of Reference 1, Appendix VII. Modifications presently in progress will increase the factor of safety of the embankment and no further studies are recommended.

7.2 Remedial Measures: Based on the visual inspection and review of existing records, there is no serious problemthat would require immediate action for the normal pool conditions. The following maintenance procedure should be initiated within 12 months.

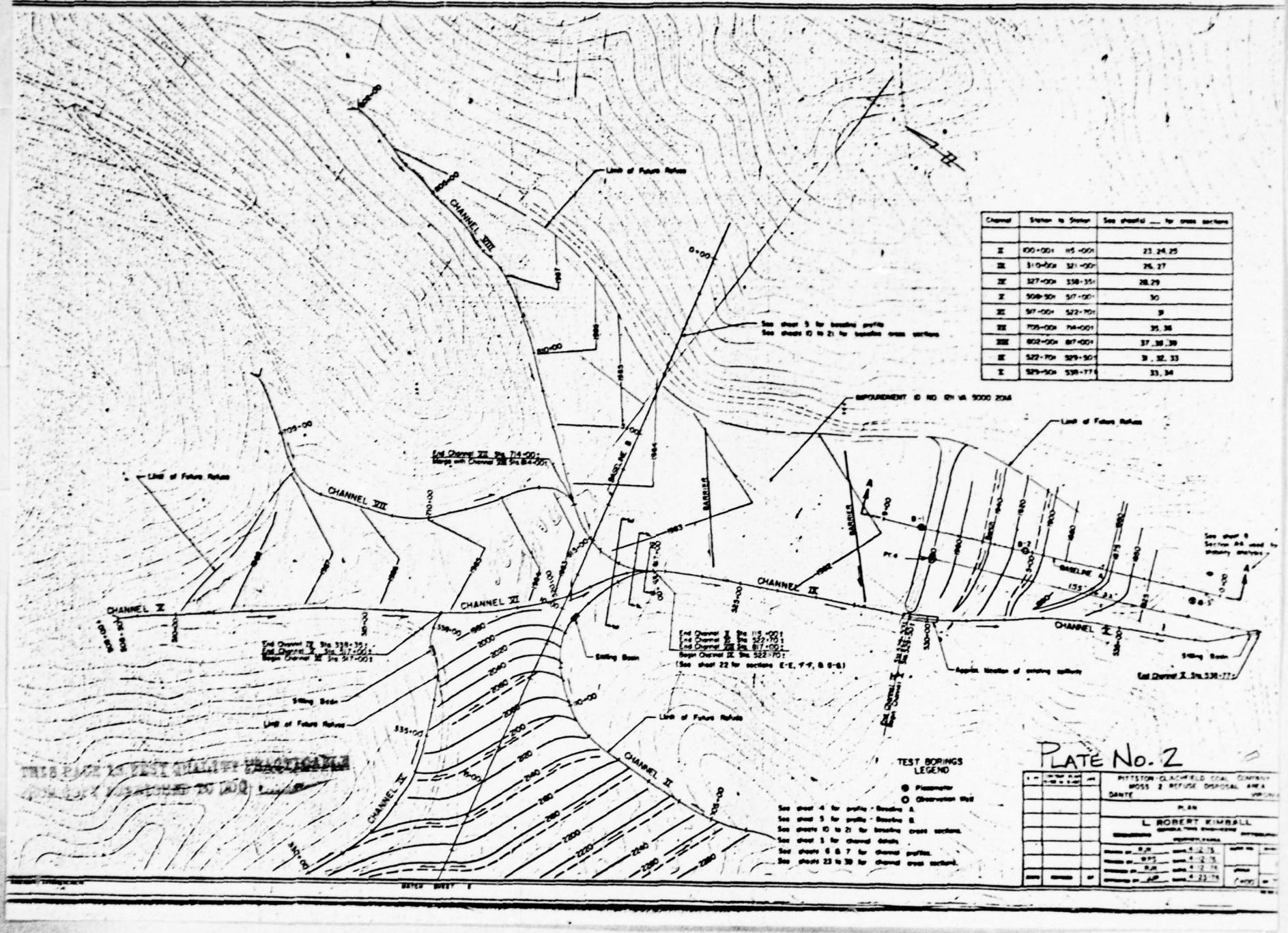
7.2.1 The erosion at the principal spillway should be repaired.

APPENDIX I

MAPS AND DRAWINGS



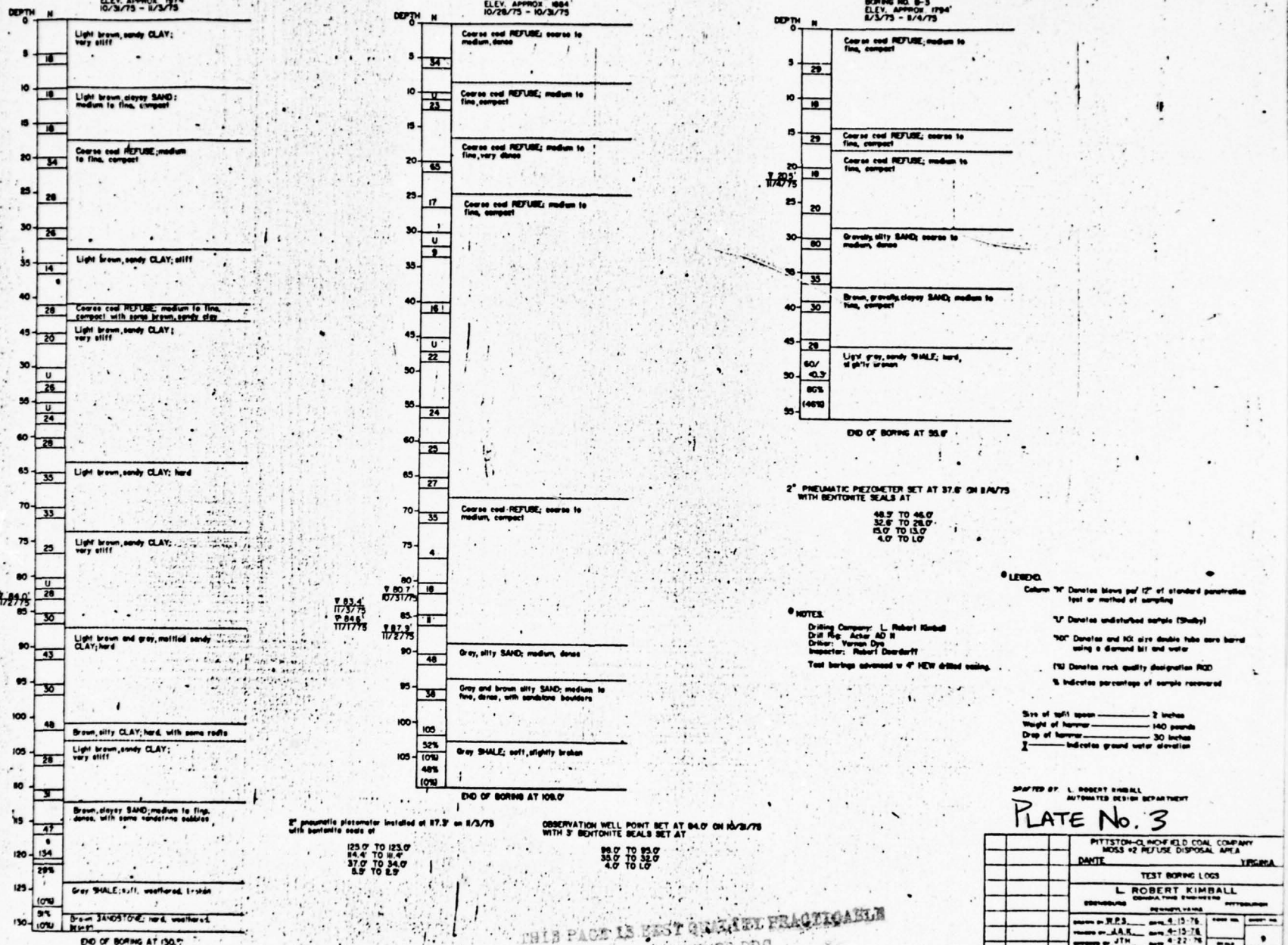
MOSS MINE # 2
Moss No 2 Mine and Preparation Plant
Substations
Water
Tailings pond
Mine dump
Conveyor
Hurricane
Wolfpen
Strip mine
Hollow
Dumps
NORFOLK AND WESTERN
Hurricane Fork
BUFF
Middle
Chaney
Creek
Fork
Sutherland Cem
Branch
Millstone
South Clinchfield
Back
Tailings pond
Ivy Ridge Ch
Mine dump
Moss No 3 Preparation Plant
Substation
South Cem
SINKHOLE
Cem
Clinchfield
Kiser Cem
Landing field
Golf Course
Branch
Lake Bonaventure
1563
Carterton
QUADRANGLE LOCATION
ILL
KENTUCKY
VA
MO
TENNESSEE
NC
MISS
ALA
GA
SC
Dante
St. Paul
Castlewood
Cleveland
Lebanon
Honaker
Richlands
SCALE: 1" = 2,000'
PLATE NO. 1
CARBO, VA.
N3652.5–8207.5/7.5



Channel	Station to Station	See sheet(s) ___ for cross sections
X	100+00± to 115+00±	23, 24, 25
IX	310+00± to 321+00±	26, 27
IX	327+00± to 338+35±	28, 29
X	508+50± to 517+00±	30
XI	517+00± to 522+70±	31
VII	705+00± to 714+00±	35, 36
VIII	802+00± to 817+00±	37, 38, 39
IX	522+70± to 529+50±	31, 32, 33
X	529+50± to 538+77±	33, 34

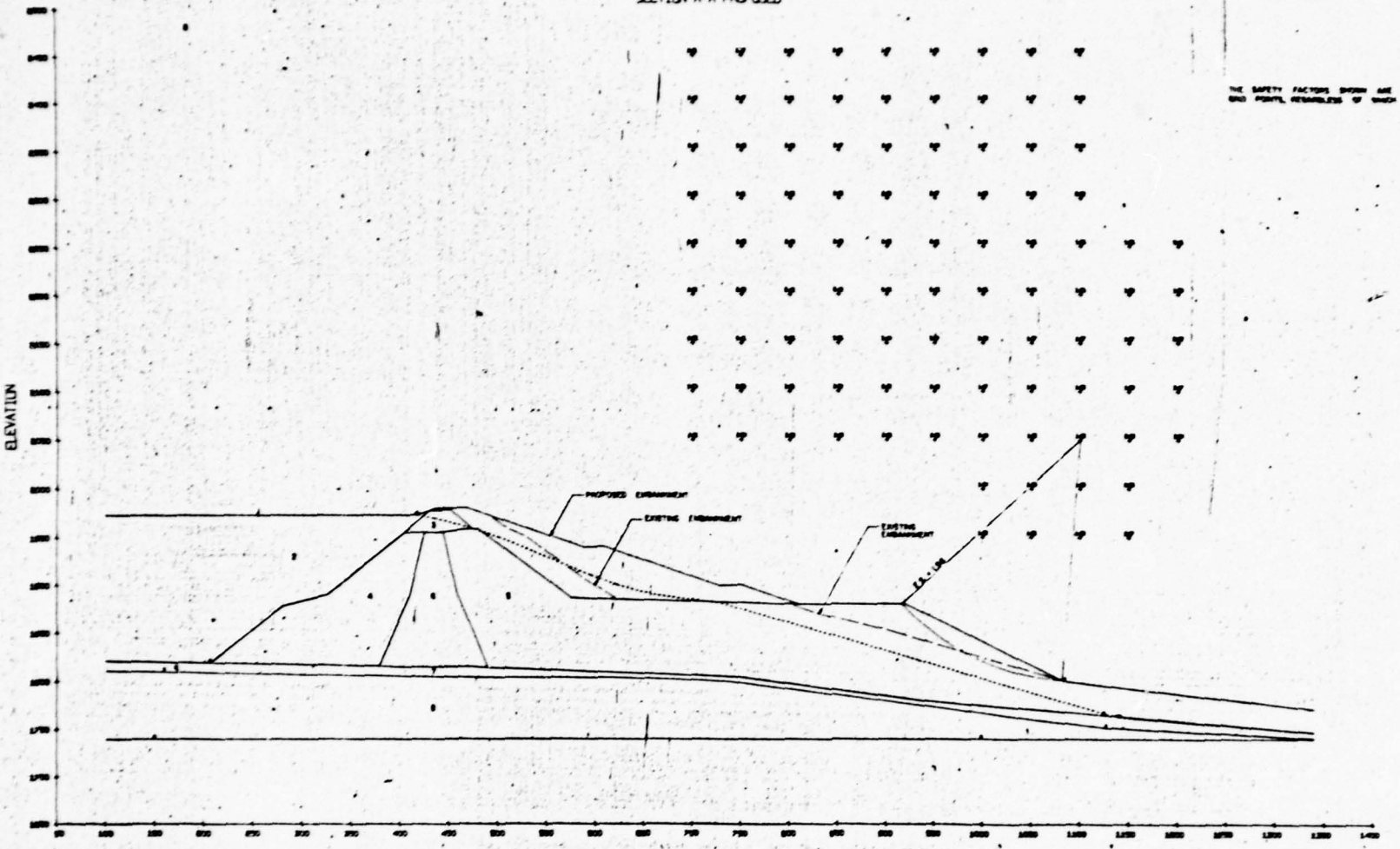
PLATE No. 2

PITTSTON CLEARFIELD COAL COMPANY
MOSS 2 REFUSE DISPOSAL AREA
DANTE VIRGINIA
PLAN
L. ROBERT KIMBALL
CONSULTING MINING ENGINEERS
BLACKSBURG, VIRGINIA
DRAWN BY RJR DATE 4-2-75
TRACED BY BMS DATE 4-2-75
CHECKED BY RJR DATE 4-2-75
APPROVED BY AJP DATE 4-23-75
SCALE 1" = 200'
DRAWING NO. 1



SIMPLIFIED BISHOP METHOD

SECTION A-A PROPOSED



THE SAFETY FACTORS SHOWN ARE THE LOWEST FOR EACH OF THE END POINTS REGARDLESS OF WHICH LAYERS WERE INTERSECTED

SOIL PARAMETERS

LAYER	[illegible]	[illegible]	[illegible]	DESCRIPTION
1	35-00	0-000	0-113	COARSE REFUSE
2	28-00	0-364	0-125	SILTSTONE
3	24-00	0-646	0-135	LIMESTONE
4	35-00	0-000	0-113	COARSE REFUSE
5	35-00	0-000	0-113	COARSE REFUSE
6	24-00	0-646	0-116	CLAY SEAM
7	24-00	0-646	0-142	FOUNDATION
8	32-00	5-556	0-145	ROCK

DRAWN BY L. ROBERT KIMBALL
AUTHORIZED DESIGN DEPT.

PLATE No. 4

PITTSTON - CLINCHFIELD COAL COMPANY
MOSS 2 REFUSE DISPOSAL AREA
DANTE VIRGINIA

STABILITY ANALYSIS

L. ROBERT KIMBALL
CONSULTING ENGINEERS
PITTSBURGH

DRAWN BY [illegible] DATE [illegible]
TRACED BY [illegible] DATE [illegible]
CHECKED BY JAS DATE 5-17-77
APPROVED BY AJP DATE 5-18-77

APPENDIX II

PHOTOGRAPHS

VIEW FROM TOP OF DAM LOOKING DOWNSTREAM AT TOE OF DAM AND MINING OPERATION IN VALLEY BELOW IMPOUNDMENT. (ARROWS DENOTE BOTH SPILLWAY LOCATIONS)

VIEW OF STILLING BASIN AND CMP WHICH DISCHARGES UNDER ROADWAY

VIEW SHOWING SEDIMENT AREA OF POND (ARROWS DENOTE TOP OF DAM PHOTO IS LOOKING DOWNSTREAM)

NEW DIVERSION CHANNEL BEING CUT INTO THE RIGHT ABUTMENT
(LOCATION IS BETWEEN CONCRETE SPILLWAY AND RIGHT
ABUTMENT)

DISCHARGE END OF CONCRETE SPILLWAY (FROM THIS POINT WATER DISCHARGES DOWN EMBANKMENT AT JUNCTION WITH RIGHT ABUTMENT, OVER RIPRAP, AND NATURAL ROCK INTO STILLING BASIN)

EROSION ON FACE OF DAM LOCATED JUST LEFT OF CONCRETE SPILLWAY

PIEZOMETERS LOCATED ALONG TOP OF DAM

CONCRETE SPILLWAY CHANNEL, WEIR AND APPROACH CHANNEL
WITH NORMAL FLOW DEPTH

VIEW OF THE END OF CONCRETE SPILLWAY (ARROW)
AND DISCHARGE CHANNEL TO STILLING BASIN

APPENDIX III

FIELD OBSERVATIONS

FIELD OBSERVATIONS

Name of Dam: Moss No. 2 Dam

County: Russell

State: Virginia

Coordinates: Lat 36°-59.3' Long 82°-11'

Date of Inspection: June 11, 1979

Weather: Fair, temperature 68°F

Pool Elevation at Time of Inspection: 1974± msl

Tailwater at Time of Inspection: 1770± msl, in CMP outlet at roadway (below basin)

Inspection Personnel:

Schnabel Engineering Associates, P.C.
Ray E. Martin, P.E.
Stephen G. Werner (recorder)

J. K. Timmons and Associates, Inc.
Robert G. Roop, P.E.
William A. Johns (recorder)

Pittston Coal Group
Verlin Altizer

Clinchfield Coal Company
Michael Holbrook

Orbital Engineering
J. E. Barrick, P.E.

State Water Control Board
Hugh Gildea, P.E.

Mine Safety and Health Administration
Frank Mann
Phil Muron, Jr.
Doug Carico

Virginia Division of Mines and Quarries
Lewis Wheatley
Arthur Reed

1 Embankment:

1.1 Surface Cracks: The downstream face was being graded at 3:1, with benches. The embankment was being constructed with coarse coal refuse and was free of vegetation.

1.2 Unusual Movement: No unusual movements were noted on the dam or downstream beyond the embankment toe.

1.3 Sloughing or Erosion: No sloughing or erosion was noted. A thin soil cover was present on the steep abutment slopes, which consist of flat-lying bedrock. The embankment material appears to withstand wash and erosion very well. Erosion exists at the downstream end of the spillway. The concrete spillway rests on fill. Erosion was also noted along the same spillway at the top berm and appears to be the result of drainage off the berm.

1.4 Alignment: The vertical and horizontal alignment of the dam was visually observed to be similar to construction drawings. The dam has been raised 3 times with the crest moved back on each occasion.

1.5 Riprap: The only riprap observed is in the spillway channel. The riprap was in good condition.

1.6 Junctions: The condition at the junction of the embankment and the abutments appear good. Erosion was observed along the right downstream embankment-abutment junction. The right abutment includes thin to massively bedded sandstone outcrops with weathered shale interbeds

and a few thin coal seams. Rock is essentially flat-lying. Ungraded fill slopes appear to be at the angle of repose.

1.7 Seepage: Seepage at about 2 gpm was occurring about halfway down the slope at the junction with the left abutment approximately 25 ft above the haul road. This seepage is believed to be unrelated to the impoundment and is considered a spring.

1.8 Staff Gage: None found.

1.9 Drains: A drainage blanket was installed at the toe of slope and up the former slope. This blanket appeared to function properly, as water was flowing from a pipe located to the right of the temporary spillway pipe. A damaged toe drain pipe to the left appeared to be blocked. The temporary spillway pipe was used during previous construction.

2 Outlet Works:

2.1 Intake Structure (Spillway): Consists of a concrete channel 10 ft wide and 5 ft deep. Also 30 inch CMP was not working. It was welded at both ends.

2.2 Outlet Structure: Channel showed spalling. of concrete.

2.3 Outlet Channel: No debris.

2.4 Emergency Gate (Emergency Spillway): Diversion channel is located in the right abutment. It is 12 ft wide at the bottom and has 1:1 side slopes. An 8 ft wide overflow channel has been excavated above the diversion

channel to allow outflow during periods of high water.

3 Reservoir:

3.1 Slopes: Very steep natural slopes with flat-lying bedrock and thin soil cover bound the reservoir. The slopes range from bare to densely wooded. A steep coal pile 100 to 150 ft± high exists along the right upstream end with slopes appearing to be at the angle of repose. A fill slope located along the left side of the reservoir is at the angle of repose and is used to form an access road. Slopes above this road and along the power line include scattered rock debris. Scattered debris was present in the upper pond. Some seepage was observed from shale exposed above the impoundment near the left abutment-dam interface.

3.2 Sedimentation: Surface sediment within the reservoir was observed to be within 30 ft± of the right abutment and 200 ft± of the left abutment.

4 Downstream Channel:

4.1 Condition: Good condition and no debris. The stilling basin at the outlet showed some silting or muddy water.

4.2 Slopes: Generally very steep wooded natural slopes with thin soil covers bound the channel. A haul road extends along the left downstream side of the embankment.

4.3 Population and Facilities: A coal preparation

plant, subsurface mine ventilation system, and small electrical substation are present immediately downstream.

5 Instrumentation:

5.1 Monumentation: None.

5.2 Observation Wells and Piezometers: Two piezometers were present. One was inoperable and the other air activated. Readings were available at the owner's office. A water observation well was installed, but was later destroyed.

APPENDIX IV

STABILITY ANALYSIS SUMMARY

By L. Robert Kimball,

Consulting Engineers

STABILITY ANALYSIS

General

In order to evaluate the stability of the embankment, triaxial shear tests were performed on undisturbed and remolded samples of coarse coal refuse to identify strength characteristics of the existing soil conditions.

Summary of Triaxial (R) Test Results

Material	Sample	ϕ Degrees	c psi	$\bar{\phi}$ Degrees	$\bar{c}$ psi
Old Refuse	B-2-9	25.5	7.3	34.5	3.5
Clay	B-1-12	21.2	0	39.4	.75
Slurry		12.7	1.5	25.2	3.5
Coarse Refuse	Remolded New Refuse	11.0	8.0	24.7	5

The effective stress parameters, as determined by triaxial testing of the coarse coal refuse, were employed in the stability analysis. Effective stress parameters were used because under long term conditions, excess pore pressures should not develop in a material with the physical properties of coarse coal refuse. The high permeability rapidly dissipates any buildup in pore pressure.

Cross-section A-A was used as a model section in evaluating the stability of the embankment because of its critical slope and/or maximum quantity of refuse material.

STABILITY ANALYSIS

The Simplified Bishop Method was used to evaluate section A-A under conditions existing at the time of drilling and mapping under static loading conditions. The seepage line in the embankment was determined from that measured from the observation wells. The measured phreatic surface was used to evaluate actual site conditions and to determine the expediency with which slope stabilization should be developed.

Stability Analysis - Existing Conditions

Condition	Type	Loading	Lowest Safety Factor
Section A-A	Bishop	Static	1.69

APPENDIX V

SUMMARY OF RECOMMENDATIONS

FOR

FUTURE USE AND ABANDONMENT PLAN

By

L. Robert Kimball,
Consulting Engineers

SUMMARY OF RECOMMENDATIONS

As shown in the construction drawings, refuse is to be placed in three areas: downstream of the impoundment, in the impoundment area, and in the main refuse area in the first left hand hollow off of the impoundment. The recommendations for future refuse deposition are as follows:

1. Stability analysis of the impoundment embankment indicates that it is in a stable condition; however, we recommend that the coal company continue placement of coarse coal refuse downstream of the impoundment. This refuse will facilitate abandonment and reduce the erosion potential of the steep front slope. The refuse should be placed with terraces as shown and reasonably conform to contour grading plan shown in the construction drawings.

2. Construct diversion channel X to provide additional spillway capacity and decrease the possibility of overtopping until the impoundment is eliminated.

3. Begin placement of refuse in the impoundment area. Placement of refuse in this area should initially be directed at construction of diversion channels. This should be accomplished by constructing refuse dikes along the alignment of each channel. The line, grade, cross-sections, and typical details of the diversion channels can be found in the construction drawings.

4. Complete construction of the diversion channels in the impoundment area to reasonably conform to the construction drawings.

5. Complete placement of refuse in the impoundment area to eliminate the impounding capability. The refuse should be placed to reasonably conform to the contours shown in the contour grading plan.

6. Construct diversion channels II, III, IV around the main refuse area. Begin preparation of the refuse area for continued refuse deposition. Because of the nature of the refuse product (coarse refuse with filter cake) it may be necessary to work some of the existing refuse down the slope to create a level platform for placement of future refuse: The operational requirements outlined in this report should be followed for continued refuse placement.

OPERATIONAL REQUIREMENTS

1. All coal refuse should be spread in shallow layers not exceeding a depth of two (2) feet and placed in a manner conforming to the contour configuration as shown on the plans. Compaction should be achieved by repeated application of heavy equipment on the working area. Care should be exercised while compacting the refuse material. The tracks of compacting vehicle should overlap the tracks of previous paths.

2. Equipment for operation of the coal refuse disposal area should be adequate in size and performance capability to continuously conduct the operation. To provide for occurrences of major equipment breakdown, standby equipment of comparable capacity should be available at the site within forty-eight (48) hours.

3. The portion of the disposal area upon which coal refuse will be deposited should be cleared of vegetation, combustible and undesirable material prior to deposition of coal refuse.

4. Access to the coal refuse disposal area should be controlled at all times to assure that unauthorized persons and vehicles are prohibited from entry.

5. Continuous operational records should be maintained including a written log which lists the quantities of coal refuse deposited. This list should be compared to projected figures relative to future use of the site.

ABANDONMENT AND RECLAMATION

1. To spread the cost of abandonment and reclamation over the anticipated life of the refuse disposal area, the spreading of cover suitable to establish durable vegetative growth should be conducted concurrently with the deposition of refuse, as refuse deposition reaches a completed bench level or stage.

2. To promote stabilization of the cover, revegetation should begin as soon as possible after the embankment has reached a completed bench level.

3. The seed or plant mixtures, quantities, method of planting, type and amount of lime fertilizer, and any other measures necessary to provide suitable vegetative cover should be in accordance with recommendations of state surface reclamation agencies.

4. The main embankment is designed to facilitate abandonment at any time by completing and covering the last level of refuse.

APPENDIX VI

INSPECTION SUMMARY

By

L. Robert Kimball, Consulting Engineers

The following site inspection summary was included in the Engineering Report for Future Use and Abandonment Plan for Moss No. 2 Coal Refuse Disposal Area:

"The site was inspected on July 19, 1973 by representatives of MESA. At the time of their inspection, the site did not appear to be a hazard. The Company was commended for complying with previous recommendations. It was recommended that: (1) the Company continue with their plans to make the site as safe as possible; and (2) during periods of high precipitation the Company should be constantly alert for any unusual conditions that may develop. At the time of this inspection, 14 feet of freeboard existed in the impoundment.

In October of 1975 the site was inspected by L. Robert Kimball, Consulting Engineers. During the period between MESA's and our inspection, conditions at the site had changed: (1) At the time of MESA's inspection, 14 feet of freeboard existed. In 1975, only six (6) feet of freeboard existed. Because of this, the danger of this impoundment being overtopped and washed out during a heavy precipitation event had increased. The size of the spillway appeared to be inadequate. (2) Since MESA's inspection, the Company had converted its coal plant facilities to a "closed water circuit". However, excess water was being discharged into the impoundment by pumping. If this pumping were to be discontinued, the need for the impoundment would no loner exist. After this site inspection, the following recommendations were made: (1) The Company should continue its monitoring of the site during periods of high precipitation. (2) Pumping of excess water from cleaning plant operations should be discontinued to allow the slurry fines to consolidate. Dugout percolation ponds should be provided for this water near the plant site. (3) The Company should continue working with its consultant engineer to safely abandon this impoundment as expeditiously as possible.

In April, 1976 we inspected the site again. During this inspection it was noted that: (1) Water was flowing through the emergency spillway and little freeboard remained at the site. (2) Additional refuse had been placed at the embankment toe and some dumped over the crest onto the downstream face. (3) Considerable seepage was noted at approximately elevation 1900; it was noted that this was the approximate contact between stage 1 and 2 dam construction. (4) No water was being pumped into the impoundment."

APPENDIX VII - REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Department of Army, Office of the Chief of Engineers, 46 pp.
2. Design of Small Dams, U.S. Department of Interior, Bureau of Reclamation, 1974, 816 pp.
3. The Geology and Coal Resources of Russell County, Virginia, Bulletin No. 22, C. K. Wentworth, Virginia Division of Mineral Resources, 1922, 179 pp.
4. HEC - 1 Flood Hydrograph Package, (Hydrologic Engineering Center, U. S. Army, Corps of Engineers, July 1978.
5. Hydrometerologic Report No. 33, U. S. Department of Commerce, Weather Bureau, U. S. Department of Army, Corps of Engineers, Washington, D.C., April 1956.
6. Future Use and Abandonment Plan for Moss #2, L. Robert Kimball Consulting Engineers, Ebensburg, Pa.